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MEMORANDUM FOR: The Director, Defense Intelligence Agency

SUBJECT : MILITARY NEWS: "Special Features in the
Training of Batteries for Firing at Low-
Flying Aerial Targets"

1. Enclosed is a verbatim translation of an article which appeared in the Soviet Ministry of Defense publication Collection of Articles of the Journal Military News (Voyennyy Vestnik). This publication is classified SECRET by the Soviets, and the issue in which this article appeared was distributed to officers from regimental commander upward.

2. In the interests of protecting our source, this material should be handled on a need-to-know basis within your office. Requests for extra copies of this report or for utilization of any part of this document in any other form should be addressed to the originating office.

FOR THE DEPUTY DIRECTOR, PLANS:

Richard Helms

RICHARD HELMS

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Original: The Director, Defense Intelligence Agency

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Assistant Director for Research and Reports

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COUNTRY : USSR

SUBJECT : MILITARY NEWS: "Special Features in the Training of Batteries for Firing at Low-Flying Aerial Targets", by Colonel T. Mikitenko

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Following is a verbatim translation of an article entitled "Special Features in the Training of Batteries for Firing at Low-Flying Aerial Targets", by Colonel T. Mikitenko. This article appeared in Issue No. 34, 1961 of the Soviet military publication Collection of Articles of the Journal Military News (Voyennyy Vestnik.) This publication is classified SECRET by the Soviets and is published by the USSR Ministry of Defense.

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Special Features in the Training of Batteries
for Firing at Low-Flying Aerial Targets

by Colonel T. Mikitenko

In modern conditions, when the main target of the organic (voyskovoye) weapons of antiaircraft defense (PVO-protivovozdushnaya oborona) is the fighter-bomber, which operates effectively at low altitudes, the firing of antiaircraft artillery at low-flying air targets acquires great importance.

Experience gained from firing exercises and calculations show that, with sufficient training of the personnel of batteries, firing of antiaircraft artillery at low-flying targets is effective. The most difficult task in carrying out these firing exercises is to ensure the necessary range of detection of low-flying targets and the timely opening of fire. However, at our firing ranges, when carrying out firing exercises, this question actually has been mastered. To detect the target at a firing range does not present any particular difficulty because the direction of its flight is known in advance. In this way there are elements of over-simplification in the training of antiaircraft artillery subunits.

By analyzing the results of firing exercises carried out in a large unit, it was established that the reasons for the bad results of individual firing exercises at low-flying targets was the late detection of the targets or the loss of targets during their tracking with the fire control radar (SON), owing to interference from terrain features and neighboring radar sites, as well as a sharp increase in firing errors and considerable lagging range deviations of the 100 mm caliber guns.

The firing exercises carried out with high indices in 1960 by all subunits and units of our large unit on No. 5 KS VZA -58 /Firing course No.5, Organic Antiaircraft Artillery-1958-No. 5 Kurs strelby voyskovaya zenitnaya artilleriya-58/show that with purposeful training and by taking into account the peculiarities of the firing exercises these problems are successfully solved.

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The minimum ranges for target detection, ensuring the normal entry into operation of the PUAZO-6 antiaircraft director, is 35-30 km. With proper training of the operators and the selection of good sites for the radars, these ranges of target detection can be attained by the radars SON-9, SON-9A, and SON-15 even in mountainous terrain.

With an angular height of less than 0-50 the detection range of a low-flying target greatly decreases, owing to the distortion of the SON directivity by the signal reflected from the ground. In connection with this the operators must know thoroughly the presentation of the local features on the SON scopes and be able to differentiate between the signal and the target on the basis of this knowledge.

In order to eliminate the cases when targets are lost owing to the interference of signals reflected from local features, as the signal from the target approaches the impulse from a local feature, the SON operator goes over to manual range-tracking of the target.

To eliminate the effect of interference from neighboring stations on the accuracy of tracking with SON, it is expedient to separate the frequencies of the magnetrons by as wide a band as possible. It is also advisable to place SON in a trench. This will ensure the screening of the station from the interference of signals reflected from local features.

In practice, the method of organizing a group search with SON for low-flying targets has justified itself, when several SON stations carry out a search on fixed angular heights in line with 0-20 to 0-50, and the operators of the stations track the target manually. This tracking of the target by the operators excludes the possibilities of the automatic equipment "cutting off". If the target is detected at angular heights in line with 0-50 to 0-70, the influence of the terrain on the directivity pattern is insignificant, which makes it possible to track the target automatically.

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The uncertain tracking of the target with SON, particularly with angular heights of the target of less than 0-50, the intense rocking of the antenna, and the considerable errors in determining angle coordinates, require the selection of the best procedure for the work of PUAZO-6 - the procedure "from the radar-only range".

The most effective method of firing at low-flying targets is with the PUAZO-6, when determining the range with SON, and obtaining the angle coordinates with the D-49 rangefinder. The firing course (KS VZA-58), however, for some unknown reasons, provides for firing at low-flying targets with the PUAZO only with data supplied by SON. Accordingly, certain commanders of batteries and directors of firing exercises deliberately violate the firing course when assigning the method for determining moving target coordinates, disregarding the fact, that for this, the evaluation of the battery will be reduced by one mark, because frequently the employment of the best procedure for PUAZO-6 work justifies itself in better firing results.

The increase in firing errors, particularly of lagging errors in range, occur as a result of the high speed with which the range changes; this leads to a considerable increase in the dynamic lag of the PUAZO tracking systems and errors in the working out of predicted target coordinates, especially of the fuze.

According to the firing tables, one can see that when firing at low altitudes the change in the setting of a fuze by one graduation produces a displacement of the burst along the trajectory nearly twice as great as when firing at high-altitude targets at corresponding ranges. The greater the range and the smaller the angular heights at the time of opening fire, the greater are the firing errors, and vice versa.

Usually the lagging errors in the range of the bursts are large at the initial firing sector. The nature of the displacement of the burst along the trajectory makes it necessary to compensate for the systematic firing errors by introducing preliminary

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corrections to the initial velocity of the shell. The experience of firing exercises carried out against low-flying targets shows that the magnitude of these corrections, depending on the peculiarities of the battery complex, fluctuates within the limits $+1.5$ to $+3$ percent.

When carrying out firing exercises at low-flying targets it is advisable to open fire on a fighter aircraft with the fuze set at 110-100 graduations, on a bomber at 90-70 graduations.

The preparation for firing with PUAZO at low-flying targets is carried out on general grounds. Besides, the battery complex is adjusted and regulated with particular thoroughness for low angular heights of the target; the average time for loading of the guns by the batteries is determined for quadrant elevation 0, 1-00 and 2-50. The accuracy of the automatic fuze-setter and its adjustment is done at the medium and small settings at every 20th graduation. To increase the stability of the gun during firing at low-flying targets, additional fastening of the gun is used, and during the firing and in the intervals between firing, the leveling and orientation of the gun are checked out.

In spite of the seeming simplicity of the direct laying in problem No. 8 of the firing course (KS VZA-58), it has been established, on the basis of a large number of exercises carried out, that literal observance of the Firing Regulations and the Firing Course for the 100 mm antiaircraft guns in the firing exercises, as a rule, is not carried out. The reason for this is the circumstance that the leads given in the Firing Regulations (table 7) are calculated for an average target velocity of 120 meters per second, but in practice the maximum speed of a target towed by an IL-28 aircraft does not exceed 100 meters per second.

And although this has been known for some time by all antiaircraft gunners, certain commanders who do not wish to trouble themselves with the bother of going into this matter continue to demand that this practice exercise should be carried out according to the calculated settings

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of the exercises.

Of course, high demands in the strict observance of the Firing Course must be inherent in all ranks of commanders, and be a law. In this case, however, the conditions of the Firing Course are violated not by the firing subunits but by the firing ranges, which do not ensure the required speed of the target in accordance with the Firing Course. This practice, in the firing of problem No. 8, is detrimental to the combat training of the antiaircraft artillery subunits.

For a definitive working out of the most expedient method of training gun crews and carrying out firing problem No. 8 under firing range conditions, we have carried out a series of experimental firing exercises.

In accordance with the firing exercises of problem No. 8 the firing exercise is carried out up to the course parameter on the second curtain of fire by one gun.

In the Firing Regulations the signal range for the second curtain of fire is not determined. "In this case fire is opened immediately after each gun has located the target" (Page 88 of the Firing Regulations).

It is natural that in firing range conditions, when firing is carried out with one gun using three shells, the uncertainty of the signal moment for the second curtain of fire and firing when the gun is ready give rise to large deviations of bursts from the target.

Therefore, in all the variations of conducting the planned and experimental firings, the signal range was determined by us with the rangefinder D-49, and was calculated for the first burst of the second curtain of fire (fuze 17) adaptable to the proposed parameters of the movement of the target (towed target).

The total number of experimental firing exercises carried out on problem No. 8 was 14.

Six firing exercises were carried out by the

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arrangements strictly laid down by the Firing Regulations on a calculated signal range adaptable to the parameters of the movement of the target. Out of these firing exercises, four were not completed and two were completed under conditions when the speed of the towing IL-28 airplane was increased to 120 meters per second, i.e. brought nearer to the speed taken as the basis for calculating the settings in table No. 7 PSZA (Antiaircraft Artillery Firing Regulations - Pravila strelby zenitnoy artillerii).

A considerable number of officers attempt to carry out the firing exercise of problem No. 8 on the calculated settings for the fuze, and the lateral leads and vertical deflection for the first, second, and third rounds. The size of the lateral lead, of the vertical sighting angle, and of the fuze are calculated by making use of the method set out in the Manual for the Study of Antiaircraft Artillery Firing Regulations. Firing exercises on these settings give good results, but there is herein, however, a flagrant breach of the Firing Regulations, consisting of the absence of a fixed curtain of fire along the line of flight of the target because the fuze settings are changeable. This complicates the work of the gun crew, requires the preparation in advance of a large number of shells with pre-set fuzes which could be mixed up by the loaders during the difficult conditions of an actual battle situation.

When carrying out the experimental firing exercises the basic requirement of the Firing Regulations was observed in placing a curtain of fire along the line of flight of the target. The other settings, with the exception of the fuze, were the calculated ones, to conform with the firing conditions. The calculations for all the firing exercises were carried out to conform with the actual conditions of flight of the target and were taken basically for a speed of 100 meters per second and a height of 600 meters.

Two experimental firing exercises on problem No. 8 were carried out on fixed fuze settings of 17 and on calculated vertical sighting angles for each round (0-34, 0-50, 0-86) and with a calculated signal range

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(2600). Both of these firing exercises were given the mark "excellent".

In spite of the successful fulfilment of the firing exercise with this method, it should be noted that the fleeting nature of this firing and the considerable speeds in the change of the target angular travel greatly complicate the work of gun crew member number three in setting leads before each round.

The work of gun crew member number three can be simplified by setting, before firing, the vertical lead for just the second round. With this in view, graduation marks (riska) are made on the elevation indicator in accordance with the size of the leads. Before each shot, gun crew member No. 4 matches the pointer of the gun indicator successively with these graduation marks. The lateral leads are set in the usual way.

The Firing Regulations are calculated for massed firing exercises and not for single gun firing with three shells, as is carried out under firing range conditions. Therefore, if the parameters of the movement of the target differ from the calculated ones, it is essential to observe the basic principal requirement of the fire along the line of flight of the target, i.e., to carry out the firing of the second curtain using fixed fuzes 17 and having the other calculated settings as follows:-

- a signal range for the first burst of the second curtain of fire;
- a fixed (averaged) vertical sighting angle;
- a lateral lead in accordance with the course parameter of the flight of the target.

The settings are calculated in conformity with the presumed conditions of flight of the target.

It should be pointed out that considerable errors in firing are made because the lateral lead is not taken into account with course parameters of the target up to 200 meters (in accordance with PS ZA for these conditions,

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the lateral lead is not set). Calculations and experience show that it is advisable to introduce a lateral lead up to 0-10 even with an insignificant but noticeable deviation of the target from the course parameter equalling zero, and with a course parameter of 100 to 200 meters it is necessary to introduce a lateral lead equal to 0-20.

Such are some of the specific features in the training and carrying out of firing exercises by our antiaircraft artillery batteries against low-flying aerial targets.

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